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CR-155773

HEAT CAPACITY MAPPING REPORT

(E78-10092) GEOLOGICAL AND GEOTHERMAL DATA
USE INVESTIGATIONS FOR APPLICATION EXPLORER
MISSION-A: HEAT CAPACITY MAPPING MISSION
Progress Report, 1 Dec. 1977 - 28 Feb. 1978
(Stanford Univ.) 10 p HC A02/MF A01

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Original photography may be purchased from
EROS Data Center

Sioux Falls, SD

February 28, 1978

HCM-014

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A-TITLE OF INVESTIGATION:

GEOLOGICAL AND GEOTHERMAL DATA USE
INVESTIGATIONS FOR APPLICATION EXPLORER
MISSION-A (HEAT CAPACITY MAPPING MISSION)

B-INVESTIGATION#:

CONTRACT NAS5-24232

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E-PERIOD:

Dec. 1, 1977--Feb. 28, 1978

F-ACTION REQUIRED:

Calibrations on all tapes with which we are
expected to read digital data i.e. radiance
or temperatures.

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G. OBJECTIVES: We have designed our HCMM experiment to verify the suitability of field measurement programs needed to achieve and relate reliable localized calibration sites to overflight data in a mineralized area. Our field measurement program will allow us to test the validity of a number of thermal models and analyze their ability to relate thermal data to rock and soil parameters. The main objective of the experiment is to determine if the use of thermal parameters related to rock density can be effectively employed in the discrimination of altered rocks stained with ferric oxide coatings derived from sulfides.

H. PROBLEMS: Two problems arose during the first stage of the project. The first problem was the delay in receiving the tapes from NASA (Goddard and Houston). The second major problem was the lack of correct documentation regarding the calibration data. The following is a list of the problems relating to calibration data that we found in our work:

- (1) How to convert the U-2 or P-3 data to degrees Kelvin, and to albedo.
- (2) What does the calibration data located at the head of the "calibrated tape" (U-2) really represent, as it varies from tape to tape? This calibration information in the U-2 HCMM tape does not agree with either the IBM output received initially from J. Price nor with later calibration received from Gary Woffard.

(3) No description of the VICAR processing has been provided, and therefore we do not know how to make the data (represented in the U2HCMR-VICAR tape) yield meaningful interpretations. What are the resamplings involved, and how does one relate the 255-element data to the real world.

H. ACCOMPLISHMENTS: The software system to process the U2-HCMR-VICAR, U2-HCMR-calibrated and P3MSS tapes has been completed and tested.

With the present program, we have the capacity to make a detailed analysis of small local areas by point-to-point registration. The system allow us to view selected channels on the 3-color Grinnell TV display, list the data numerically, or make simulated-gray level pictures ("Dotprints") on a Printronix matrix printer.

Following is an example of the point-to-point registration using Dotprints. Figure 1 is a "panoramic corrected" Dotprint showing part of the Weed Heights near Yerington, Nevada. The dotprint was obtained using the raw numeric data in the infrared channel from the U2-HCMR calibrated tape (U-2 Flight 77.130, HCM Flight 18). The area inside the square in Figure 1 has been enlarged and is shown in Figure 2. The raw raw numeric data (infrared channel) corresponding to the area inside the square is shown in Table 1. The numbers in the figures represent the coordinates of the U2-HCMR calibrated tape. The enlarged area in Figure 2 is part of a tailing pond in the mine dump area, for which we have ground truth data. Note that the image (Figure 1 and 2) is not "flipped horizontally" i.e. as originally taken, therefore WEST is to the left, EAST to the right.

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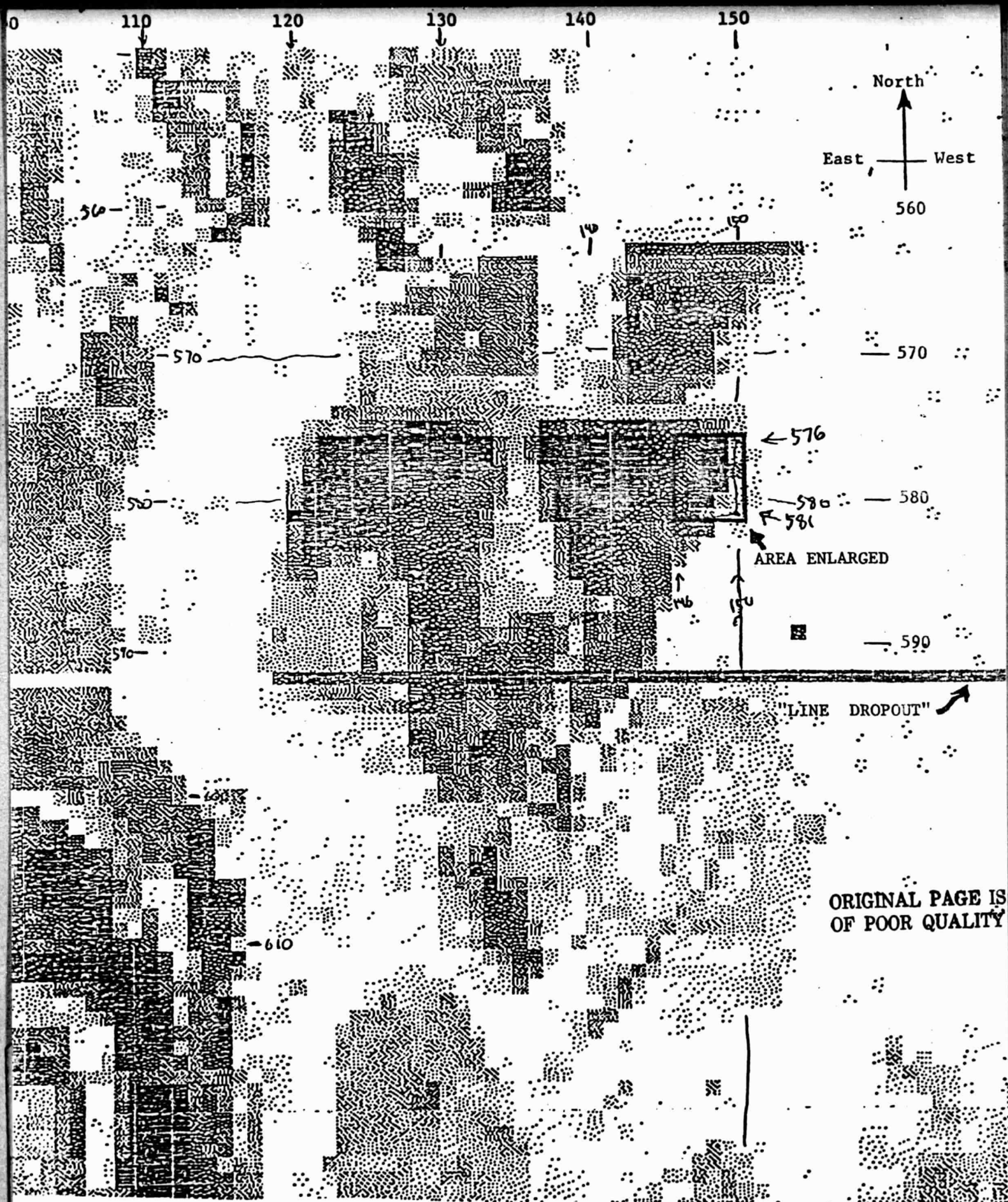


Figure 1. "Panoramic corrected" Dotprint showing part of the Weed Heights in Yerington, Nevada. The Dotprint was obtained using raw numeric data in the infrared channel (day) from the U2-HCMR calibrated tape.

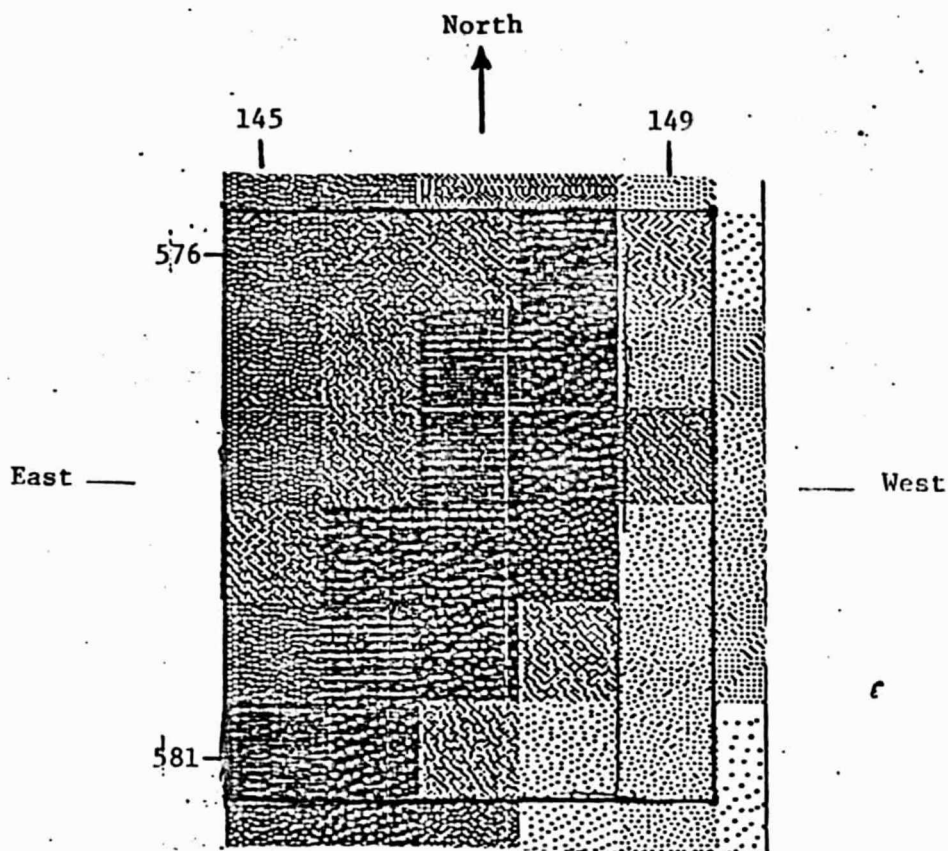


Figure 2. Enlarged "panoramic corrected" Dotprint for part of the tailing pond. The raw numeric data for the infrared channel from Table 1 (U2-HCMR) was used to produce the Dotprint.

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In order to analyse the numeric data corresponding to the radiance and temperature for the infrared channel and the reflectance for the visible channel we extracted the data from the U2-HCMR calibrated tape corresponding to the area shown in Figure 2 and compared it with the IBM output provided by NASA/GSFC. Table 1 lists the raw numerics and calibration data from the U2-HCMR calibrated tape, and Table 2 shows the calibration data from the IBM output. Tables 1 and 2 indicate that there is no correspondence between these radiance and temperatures sets, which means that some problems (not yet clarified) exist in the data. The table, however does show that there is agreement between the IBM output and the U2HCMR tape for the reflectance data in the visible.

TABLE 1. RAW NUMERIC AND CALIBRATION DATA EXTRACTED FROM THE U2-HCMR CALIBRATED TAPE.

 HCM HEAT CAP. MAPPER
 U-2 FLIGHT 77.130
 HCM FLIGHT 18
 YERINGTON, NEVADA

HCMR FLIGHT INSTRUMENT MASTER CALIBRATION TABLES
 @75#346

AREA IS 576 TO 581 SCANLINES DOWN FROM THE START=0
 145 TO 149 PIXELS IN FROM LEFT EDGE=0

INFRARED BAND

RAW DATA MATRIX (WINDOW)

	COLUMN :	(145)		(149)
ROW: (576)	500	512	531	460 605
	501	538	445	468 623
	504	535	446	468 536
	533	464	467	482 640
	502	454	470	591 625
(581)	451	467	588	639 628

CALIBRATION TABLE (EXTRACT)

RAW	BYTE#	OCTAL	RADIANCE	OCTAL	TEMPERATURE
445	1777:2000	7637366552	.00192150	10304563065	302.388
446	1781:1784	7637404102	.00192310	10304563453	302.448
451	1801 ...		.00193110		302.746
454	1813		.00193590		302.926
460	1837		.00194550		303.283
464	1853		.00195190		303.521
467	1865		.00195670		303.699
468	1869		.00195830		303.758
470	1877		.00196150		303.877
482	1925		.00198070		304.586
500	1997		.00200950		305.642
501	2001		.00201110		305.700
502	2005		.00201270		305.759
504	2013		.00201590		305.876
512	2045		.00202870		306.342
531	2121		.00205910		307.443
533	2129		.00206230		307.558
535	2137		.00206550		307.673
536	2141		.00206710		307.731
538	2149		.00207030		307.846
588	2349		.00215030		310.694
591	2361		.00215510		310.863
605	2417		.00217750		311.649
623	2489		.00220630		312.653
625	2497		.00220950		312.765
628	2509		.00221430		312.932
639	2553		.00223189		313.541
640	2557		.00223349		313.596

VISIBLE BAND

RAW DATA MATRIX (WINDOW)

COLUMN:	(145)	(149)
ROW: (576)	242 294 298 250 307	
	246 303 250 246 307	
	263 311 250 242 268	
	311 263 246 250 316	
	285 250 242 290 368	
(581)	255 246 294 350 398	

CALIBRATION TABLE (EXTRACT)

RAW	BYTE#	REFLECTANCE
242	965	.231
246	981	.235
250	997	.239
255	1017	.244
263	1049	.252
268	1069	.257
285	1137	.274
290	1157	.279
294	1173	.283
303	1209	.292
307	1225	.296
311	1241	.300
316	1261	.305
350	1397	.339
368	1469	.357
398	1589	.387

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TABLE 2. CALIBRATION DATA FROM IBM OUTPUT (NASA/GSFC)

HCMR FLIGHT MASTER CALIBRATION TABLES

NAME= 076#089

LENGTH=1024 ELEMENTS

TABLE GENERATION PARAMETERS

INFRARED			VISIBLE		
LOCATION	BASE VALUE	INCREMENT	LOCATION	BASE VALUE	INCREMENT
2	1.0294E-03	2.1000E-06	11	0.0	1.0000E-03

INFRARED BAND

VISIBLE BAND

INDEX	RADIANCE	TEMPERATURE	INDEX	REFLECTANCE
445	.0019597	303.8103	242	0.231
446	.0019618	303.8879	246	0.235
451	.0019723	304.2761	250	0.239
454	.0019786	304.5083	255	0.244
460	.0019912	304.9717	263	0.252
464	.0019996	305.2798	268	0.257
467	.0020059	305.5105	285	0.274
468	.0020080	305.5874	290	0.279
470	.0020122	305.7407	294	0.283
482	.0020374	306.6577	303	0.292
500	.0020752	308.0220	307	0.296
501	.0020773	308.0974	311	0.300
502	.0020794	308.1726	316	0.305
504	.0020836	308.3232	350	0.339
512	.0021004	308.9241	368	0.357
531	.0021403	310.3408	398	0.387
533	.0021445	310.4890		
535	.0021487	310.6372		
536	.0021508	310.7112		
538	.0021550	310.8591		
588	.0022600	314.5090		
591	.0022663	314.7251		
605	.0022957	315.7295		
623	.0023335	317.0110		
625	.0023377	317.1526		
628	.0023440	317.3650		
639	.0023671	318.1411		
640	.0023692	318.2114		

J. SIGNIFICANT RESULTS: Analysis of local areas by point-to-point ,

registration has been achieved.

K. PLANNING FOR NEXT PERIOD: Use of thermal parameters as detected by

HCMR data in conjunction with thermal modelling.

L. PUBLISHED MATERIALS: None

M. RECOMMENDATIONS: Provide calibrations with taped data

N. CHANGING IN STANDING ORDER FORMS: None

O. DATA REQUEST FORMS SUBMITTED: None

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